Progress Report

Germ Plasm Evaluation Program

Report No. 1

U.S. Meat Animal Research Center

In cooperation with
Kansas State University
and the University of Nebraska

ARS-NC-13
March 1974

NORTH CENTRAL REGION

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

U.S. MEAT ANIMAL RESEARCH CENTER

GERM PLASM EVALUATION PROGRAM[1]

PROGRESS REPORT

The cattle germ plasm evaluation program at the U.S. Meat Animal Research Center is designed to characterize breeds representing different biological types in the full spectrum of economic traits relating to growth, feed efficiency, reproduction, maternal ability and carcass and meat traits. The basic objective of this program is to develop an understanding relating to optimizing such biological factors as cow size, milk level, etc., in different feed environments and production situations.

The program was started with the 1969 breeding season. The first cycle (Cycle 1, Phase I) involved breeding by artificial insemination (AI), Hereford, Angus, Jersey, South Devon, Limousin, Simmental and Charolais bulls to Hereford and Angus cows. The three calf-crops for Cycle 1, Phase I of the program were born in March, April and early May of 1970, 1971 and 1972 and were weaned in October or November at approximately 200 days of age. All male calves were fed out as steers and slaughtered to evaluate growth, feed efficiency and carcass and meat traits. All female progeny were retained for evaluation of reproduction and maternal traits (Cycle 1, Phase II). Mating plans are given in the appendix tables on the part of the program for which results are presented in this report.

The second cycle (Cycle 2, Phase I) was started with the 1972 breeding season and will include two calf-crops (1973 and 1974). Brown Swiss and Red Poll female populations were added to the Hereford and Angus cow herds used in Cycle 1, Phase I. The Hereford and Angus females were bred by AI to Hereford, Angus, Brown Swiss, Red Poll, Maine Anjou, Gelbvieh and Chianina bulls and the Red Poll and Brown Swiss females were bred to Hereford, Angus, Red Poll and Brown Swiss bulls. Information obtained on the second cycle of breeds will be similar to that obtained on the first cycle.

This report provides a summary from the three calf-crops produced in Cycle 1, Phase I on calving difficulty and preweaning growth on all calves; postweaning growth, feed efficiency and carcass and meat traits on steers; and postweaning growth, puberty and conception as yearlings on the heifers. Calving and rebreeding information is included on the 2-year-old cows that were born in the 1970 and 1971 calf-crops of Cycle 1, Phase I (designated Cycle 1, Phase II) and on the 3-year-old cows born in the 1970 calf-crop of Cycle 1, Phase I (designated Cycle 1, Phase II). Data are included on Cycle 2, Phase I on calving difficulty and preweaning growth for the 1973 calf-crop.

---

[1] U.S. Meat Animal Research Center, ARS, USDA, Clay Center, Nebraska 68933; Standardization Branch, AMS, USDA; Kansas State University, Manhattan; and the University of Nebraska, Lincoln; cooperating.

CYCLE 1, PHASE I

Cows. The foundation Hereford and Angus cows used in the program were purchased as calves at weaning from commercial producers in Nebraska. The cows were 2-, 3-, 4- and 5-year-olds at calving in 1970; 2-, 3-, 4-, 5- and 6-year-olds at calving in 1971; and 3-, 4-, 5-, 6- and 7-year-olds at calving in 1972.

Sires. There were 32 Hereford, 35 Angus, 33 Jersey, 28 South Devon, 20 Limousin, 28 Simmental, and 26 Charolais bulls used during the 1969, 1970 and 1971 breeding seasons. The Hereford and Angus bulls used in this program were sampled from bulls which had been selected on individual performance information as a basis for gaining entry into the progeny testing program of artificial insemination organizations. These same Hereford and Angus sires are used as controls in all cycles and phases of the Germ Plasm Evaluation Program so that comparisons among sire breeds can be made across all cycles and phases by comparing deviations from the Angus-Hereford and Hereford-Angus crossbred controls. The Jersey bulls were selected at random from two commercial AI organizations and the South Devon bulls were sampled from an importation made in 1969 by a commercial organization. Simmental, Limousin and Charolais bulls were sampled from bulls available from commercial organizations and from the Canada Department of Agriculture for the Simmental and Limousin.

It is not planned to make general releases of information on individual sires, because erroneous conclusions may be drawn from the ranking of individual sires with the relatively small number of progeny per sire in this program. The objective of the program is to characterize breeds representing different biological types. To do this effectively, it is necessary to sample a large number of sires of each breed. Thus, the number of progeny per sire is generally low. A relatively large number of progeny per sire are required for a high level of accuracy in ranking individual sires on their breeding value for most economic traits.

For a cooperative study with the Canada Department of Agriculture, Hereford x Angus, Jersey x Angus, Simmental x Angus, and Charolais x Angus heifers were randomly selected at weaning time and shipped, 4 to 8 weeks after weaning, to the Research Station, Lethbridge, Alberta. There were 12 heifers per breed group in 1970 and 10 heifers per breed group in 1971 and 1972. These females and their offspring are being individually fed to evaluate efficiency of production.

Calving Difficulty. Data were obtained on 2,563 calvings. Calving difficulty scores were assigned to each calf at birth on the basis of the following scoring system:

Score		Description
1	No difficulty	- Calves unassisted; however, it may be necessary to straighten head and/or front legs.

2	Little difficulty	- Assistance given by hand, but no jack or puller used; assistance actually may not have been required.
3	Moderate difficulty	- Assistance given with jack or calf-puller; some difficulty was encountered even with the pullers being used.
4	Major difficulty	- Calf jack used and major difficulty encountered; usually 30 minutes or more required to deliver calf.
5	Caesarean birth	- Performed after it was determined calf could not be delivered with a calf-puller.
6	Posterior presentation	- Assistance given.

Table 1 provides a summary of calving difficulty for cows calving at 2 years of age and table 2 a summary for cows calving at 3 to 7 years of age. For these summaries (tables 1 and 2) scores of 1 and 2 were combined and are designated no difficulty and scores of 3 and 4 were combined and are designated calf-puller. No 2-year-old females produced calves in this program in 1972.

Preweaning Growth. Preweaning growth information for the 1970-71-72 calf-crops are summarized in table 3. This summary includes data on 2,264 calves. These data were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of year, calf sex, age of dam, breed of sire, breed of dam, breed-of-sire by breed-of-dam interaction, with calf birth date as a covariate. The data were adjusted to a steer basis and to a 5-6-7-year-old cow basis. Adjustment factors were developed from the combined data and were as follows:

	Birth Wt.	Preweaning A.D.G.	200-Day Wt.
Heifer calf adj.	+5.4	+0.103	+26
Steer calf adj.	0	0	0
2-year-old dam	+8.0	+0.396	+87
3-year-old dam	+6.3	+0.191	+44
4-year-old dam	+2.5	+0.066	+16
5-6-7-year-old dam	0	0	0

Calves were creep fed a ration of whole oats from about mid-July until weaning. Creep feed consumption averaged 286 lb./calf in 1970, 308 lb./calf in 1971, and 304 lb./calf in 1972.

Postweaning Growth and Feed Efficiency. Postweaning growth and feed efficiency data were obtained on 1,123 steers from the 1970-71-72 calf-crops. Rations for each of the three years are presented in table 4. Summaries of average daily gain, adjusted final weight, and feed efficiency are presented in table 5. Approximately one-third of the steers were slaughtered at each of three slaughter dates as described in the carcass and meat section.

At weaning, steer calves with adjusted weaning weights more than three standard deviations below the mean for their breeding group were removed from the program. The remaining steers were placed in the feedlot by breed of sire groups (replicated, two lots per breed of sire) to obtain data on growth rate and feed efficiency. In 1970, steers sired by Simmental and Charolais sires were further divided into lots by breed of dam and replicated during the postweaning feeding period.

The postweaning average daily gains are based on actual weaning weights (no weaning shrink) and final weights at slaughter. Final weights at slaughter were obtained as the average of two weights (on feed and water) taken on different days to reduce errors due to differences in fill. Adjusted final weights were obtained by adding the sum of postweaning average daily gain x days on feed, to weaning weight adjusted to 200 days of age, and then adjusted for year and to a 5-6-7-year-old dam basis. Average daily gains and adjusted final weights for the three slaughter groups are only for the steers slaughtered in that group. Feed efficiency for each breed group was obtained by dividing the cumulative average daily TDN consumption per steer by the average daily gain of the steers remaining on feed up to each of the three slaughter dates. Metabolizable energy (Mcal.) was obtained by multiplying pounds TDN by 1.64.

The data were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of year, age of dam, breed of sire, breed of dam, slaughter group, the interactions of breed-of-sire by breed-of-dam, breed-of-sire by slaughter group, breed-of-dam by slaughter group, and breed-of-sire by breed-of-dam by slaughter group.

Carcass and Meat. Carcass and meat data from the 1,123 steers are presented in tables 6 to 9. Approximately one-third of the steers in each breed-of-sire by breed-of-dam group were slaughtered at each of three slaughter dates, which were 215, 243 and 271 days on feed after weaning for the 1970 calf-crop; 200, 242 and 284 days on feed after weaning for the 1971 calf-crop; and 220, 255 and 283 days on feed after weaning for the 1973 calf-crop. The steers slaughtered at each of the three times had approximately the same average birth date, resulting in an average difference in age of steers for the three years of 35 days between slaughter groups 1 and 2 and of 32 days between slaughter groups 2 and 3.

Steers were transported to a commercial slaughter plant approximately 12 hours prior to slaughter. Carcass data were obtained after a 24-hour chill. Carcasses were evaluated for conformation, maturity, marbling, color, texture and firmness and U.S.D.A. Quality Grade by representatives of the U.S. Meat Animal Research Center; Standardization Branch, A.M.S., U.S.D.A.; and Kansas State University. Loin eye area and external fat thickness were measured and U.S.D.A. Yield Grade determined. These results are presented in tables 6 and 7. In addition, selected linear carcass measurements and measures of other traits were obtained, but are not included in this report.

After obtaining cooler carcass data, the right side of each carcass was transported from the commercial slaughter plant to Kansas State University for detailed cut-out and meat quality evaluation. The right side was separated into wholesale cuts, and the wholesale cuts were processed into closely trimmed, boneless cuts, except dorsal and transverse spinous processes were left in short loin cuts and dorsal spinous processes and rib bones were left in rib cuts. No more than 0.30 inch of fat was left on any surface. The amounts of retail product, fat trim and bone were determined for each wholesale cut. These results are presented on a percentage of carcass weight basis in table 8.

One steak was removed at the 11th rib from each carcass for Warner-Bratzler shear determination. The steaks were cooked at 350°F to an internal temperature of 150°F. After cooling for approximately 30 minutes at room temperature, one-half inch cores were removed for shear determination. Steaks were removed at the 10th rib from four representative carcasses per breed group per slaughter date, cooked at 350°F to an internal temperature of 160°F, and subjected to taste panel evaluation for tenderness, flavor, juiciness and overall acceptability by trained taste panelists. These results are presented in table 9.

The following additional carcass information was obtained on the 1971 calf-crop, but is not included in this report. The 9-10-11th ribs were removed from the left side of each carcass for chemical analyses. Total chemical composition (water, nitrogen and fat) was determined on the left side of the carcass from three representative steers of the Hereford x Angus, Simmental x Angus, and Limousin x Angus breed groups per slaughter group (a total of 27 carcass sides, 9 per breed group).

The data for the carcass and meat traits were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of year, age of dam, breed of sire, breed of dam, slaughter group, the interactions of breed-of-sire by breed-of-dam, breed-of-sire by slaughter group, breed-of-dam by slaughter group, and breed-of-sire by breed-of-dam by slaughter group. Thus, the least-squares means for the carcass and meat traits are adjusted for year and to a mature age-of-dam basis.

CYCLE 1, PHASE II

Postweaning Growth, Puberty and Conception. Postweaning growth, age at puberty and conception of yearling heifers produced in the 1970-71-72 calf-crops are presented in table 10. The heifers were maintained in the feedlot from weaning (November in 1970, October in 1971 and 1972) through the AI breeding period (early July). The postweaning ration was 50% corn silage and 50% grass silage fed ad libitum, or a grass silage and concentrate mixture to provide an equivalent energy intake.

Date of puberty, defined as date of the first observed standing estrus, was determined by checking animals for estrus twice daily. Weights were taken every 28 days from weaning to the breeding period and again at the termination of the breeding period. Heifers were inseminated only after they were observed in standing estrus. Following a 45- or 46-day AI breeding period, the heifers were placed on pasture for a 21-24-day natural service (cleanup) breeding period. Estrus was determined from weaning to an average of approximately 15 months of age (end of AI) for the 1970 calf-crop and to an average of approximately 16 months of age (end of AI plus cleanup) for the 1971-72 calf-crops.

Calving and Rebreeding of 2- and 3-Year-Olds. Data on calving and rebreeding as 2-year-olds are complete on the heifers born in Cycle 1, Phase II in 1970 and 1971. Data on calving difficulty and rebreeding as 3-year-olds are complete on the heifers born in Cycle 1, Phase I in 1970. Calving difficulty data for the 2-year-olds are presented in table 11 and other reproduction data are presented in table 12. Yearling heifers were bred by AI to calve as 2-year-olds to Hereford, Angus, Brahman, Devon and Holstein bulls and to Hereford and Angus bulls during the cleanup period in 1971. The heifers born in 1972 (Cycle 1, Phase I) were also bred as yearlings to these same breeds of sires. Thus, the data presented in tables 11 and 12 are for only two of three years that will be obtained and have not been subjected to a complete statistical analyses.

Because the number of calves in each breed of sire group were disproportionate among the cow breed groups and, because there was a small number of calves in some of the breed-of-sire by breed-of-cow subgroups, weaning weights of the calves for both the 2- and 3-year-olds are not presented. After data for the three calf-crops are obtained, these data will be analyzed and the results published.

After calving as 2-year-olds, the cows born in 1970 (Cycle 1, Phase II) were bred by AI to Hereford, Angus, Gelbvieh, Maine Anjou and Chianina bulls and during the cleanup period to Hereford and Angus bulls. Calving difficulty data for this first group of 3-year-olds are presented in table 13 and other reproduction data are presented in table 14.

CYCLE 2, PHASE I

Cows. The foundation Hereford and Angus cows used in Cycle 1, Phase I were continued in Cycle 2, Phase I of the program. These cows calved in 1973 at 4, 5, 6, 7 and 8 years of age. As previously indicated, mature Brown Swiss and Red Poll cows were added to these herds for the 1972 breeding season.

Sires. There were 14 Hereford, 16 Angus, 16 Red Poll, 6 Brown Swiss, 4 Gelbvieh, 10 Maine Anjou and 10 Chianina bulls used during the 1972 breeding season. The Hereford and Angus sires had also been used in Cycle 1, Phase I of the program and the other bulls were sampled from commercial organizations. The Brown Swiss sires included the four available imported bulls and two domestic bulls.

Calving Difficulty. For convenience of comparison, the data are presented separately for the seven sire breeds with Hereford and Angus dams (table 15) and for the Hereford, Angus, Red Poll and Brown Swiss sires with the same four dam breeds (table 16). Calving difficulty data were available on 847 calvings. The same system for scoring calving difficulty was used in this cycle as was used in Cycle 1, Phase I, except in Cycle 2 all abnormal and posterior presentations were grouped together and given a score of 6, while in Cycle 1, Phase I the occasional positioning of a calf was made before the calving difficulty score was assigned and the difficulty score was then based on the amount of difficulty encountered.

Preweaning Growth. These data were grouped for breed group comparisons in the same manner as the calving difficulty data. Preweaning growth data were available on 772 calves. These data were analyzed by least-squares procedures using a model that included calf sex, breed of sire, breed of dam and breed-of-sire by breed-of-dam interaction with calf birth date as a covariate. The data were adjusted to a steer basis with the adjustment calculated from the data. Adjustment factors for heifer calves were +2.2 lb. for birth weight, +0.041 lb. for average daily gain and +10.5 lb. for 200-day weight. Calves were creep fed whole oats from mid-August until weaning. Creep feed consumption was 46 lb./calf.

TABLE 1. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY IN 2-YEAR-OLD COWS
CYCLE 1, PHASE I - 1970-71 CALF-CROPS

Breed of Sire	Breed of Dam	No. Calves	Type of Parturition, %				Dead at or Shortly After Birth, %
			No Calving Difficulty[a]	Calf-Puller	C-Section	Posterior Presentation	
Hereford	Hereford	67	43.3	52.2	4.5	0.0	7.5
Angus	Angus	83	62.7	36.1	1.2	0.0	8.4
	Average[b]	150	53.0	44.2	2.9	0.0	8.0
Angus	Hereford	77	54.5	41.6	1.3	2.6	7.8
Hereford	Angus	86	61.6	37.2	1.2	0.0	3.5
	Average[b]	163	58.1	39.4	1.3	1.3	5.7
Jersey	Hereford	61	80.3	19.7	0.0	0.0	1.6
	Angus	76	85.5	13.2	1.3	0.0	5.3
	Average[b]	137	82.9	16.5	0.7	0.0	3.5
South Devon	Hereford	28	53.6	42.9	3.6	0.0	7.1
	Angus	45	35.6	62.2	2.2	0.0	13.3
	Average[b]	73	44.6	52.6	2.9	0.0	10.2
Limousin	Hereford	63	17.5	74.6	6.3	1.6	11.1
	Angus	58	32.8	65.5	1.7	0.0	6.9
	Average[b]	121	25.2	70.1	4.0	0.8	9.0
Simmental	Hereford	27	11.1	63.0	25.9	0.0	14.8
	Angus	37	40.5	51.4	5.4	2.7	10.8
	Average[b]	64	25.8	57.2	15.7	1.4	12.8
Charolais	Hereford	37	21.6	54.1	21.6	2.7	16.2
	Angus	34	23.5	67.6	8.8	0.0	11.8
	Average[b]	71	22.6	60.9	15.2	1.4	14.0
Average All Sire Breeds	Hereford[b]	360	43.6	48.6	6.7	1.1	8.6
	Angus[b]	419	54.4	43.0	2.4	0.2	7.6
	Average[b]	779	49.0	45.8	4.6	0.7	8.1

[a] No assistance or minor hand assistance.
[b] Unweighted means.

TABLE 2. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY IN 3-4-5-6-7-YEAR-OLD COWS
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Breed of Sire	Breed of Dam	No. Calves	Type of Parturition, %				Dead at or Shortly After Birth, %
			No Calving Difficulty[a]	Calf-Puller	C-Section	Posterior Presentation	
Hereford	Hereford	100	95.0	3.1	0.0	4.0	4.0
Angus	Angus	94	94.7	4.3	1.1	0.0	2.1
	Average[b]	194	94.9	3.7	0.6	2.0	3.1
Angus	Hereford	112	91.1	1.8	0.0	7.1	0.9
Hereford	Angus	150	95.3	2.7	0.0	2.0	0.0
	Average[b]	262	93.2	2.3	0.0	4.6	0.5
Jersey	Hereford	67	98.5	1.5	0.0	0.0	3.0
	Angus	108	99.1	0.0	0.0	0.9	1.9
	Average[b]	175	98.8	0.8	0.0	0.5	2.5
South Devon	Hereford	92	77.2	16.3	1.1	5.4	4.3
	Angus	76	88.2	7.9	0.0	3.9	3.9
	Average[b]	168	82.7	12.1	0.6	4.7	4.1
Limousin	Hereford	140	85.0	11.4	0.0	3.6	5.7
	Angus	127	89.8	6.3	0.0	3.9	2.4
	Average[b]	267	87.4	8.9	0.0	3.8	4.1
Simmental	Hereford	178	80.9	15.2	0.6	3.4	7.9
	Angus	186	84.4	12.4	0.0	3.2	3.8
	Average[b]	364	82.7	13.8	0.3	3.3	5.9
Charolais	Hereford	164	70.7	24.4	0.0	4.9	11.0
	Angus	190	81.1	13.7	0.0	5.3	6.3
	Average[b]	354	75.9	19.1	0.0	5.1	8.7
Average All Sire Breeds	Hereford[b]	853	83.6	12.0	0.2	4.2	6.0
	Angus[b]	931	89.3	7.6	0.1	3.0	3.1
	Average[b]	1784	86.5	9.8	0.2	3.6	4.6

[a] No assistance or minor hand assistance.
[b] Unweighted means.

TABLE 3. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS OF PREWEANING TRAITS - 1970-71-72 CALF-CROPS
CYCLE 1, PHASE I

Breed of Sire	Breed of Dam	No. Calves[a]	Birth Date	Birth Wt., lb.[b]	Preweaning ADG, lb.[b]	Adjusted 200-Day Wt., lb.[b]	200-Day Wt. Ratio[c]
Hereford	Hereford	132	April 1	83.5	1.83	450	94.7
Angus	Angus	157	March 27	76.0	1.96	469	98.7
	Average	289	March 29	79.8	1.90	459	96.6
Angus	Hereford	179	March 31	82.0	1.91	464	97.7
Hereford	Angus	203	March 28	81.1	2.03	487	102.5
	Average	382	March 30	81.6	1.97	475	100.0
Jersey	Hereford	116	March 31	74.8	1.87	449	94.5
	Angus	167	March 24	71.1	1.92	455	95.8
	Average	283	March 28	73.0	1.90	452	95.2
South Devon	Hereford	107	April 2	88.1	1.89	467	98.3
	Angus	108	March 31	83.3	2.03	490	103.2
	Average	215	April 1	85.7	1.96	478	100.6
Limousin	Hereford	179	April 11	88.4	1.93	473	99.6
	Angus	174	April 7	84.7	2.06	498	104.8
	Average	353	April 9	86.5	1.99	485	102.1
Simmental	Hereford	182	April 6	93.5	1.99	492	103.6
	Angus	202	April 1	88.6	2.10	510	107.4
	Average	384	April 3	91.1	2.05	501	105.5
Charolais	Hereford	163	April 4	93.9	2.00	493	103.8
	Angus	195	March 31	90.0	2.13	516	108.6
	Average	358	April 2	91.9	2.06	505	106.3
Average	Hereford	1058	April 3	86.3	1.92	470	98.9
All Sire	Angus	1206	March 31	82.1	2.03	489	102.9
Breeds	Average	2264	April 1	84.2	1.98	479	100.8

[a] Includes all steer and heifer calves that were weaned.
[b] Adjusted for birth date and to a steer and a mature age of dam basis.
[c] Ratio computed relative to average of 475 lb. for Angus-Hereford and Hereford-Angus crossbred controls.

TABLE 4. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
POSTWEANING STEER FEEDLOT RATIONS
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Calf-Crop, Year	Period	Ingredients			Ration Analyses, 90% D.M. Basis[a]			
		Corn Silage, %	Concentrate, %[b]	Supplement, %[c]	C.P., %	D.P., %	TDN, %	Mcal. M.E./lb.
1970	Nov. 17 - Nov. 24	89.0	7.5	3.5	10.6	8.1	64.8	1.06
	Nov. 25 - Jan. 10	77.5	17.5	5.0	11.6	8.9	68.0	1.12
	Jan. 11 - Slau.	60.0	35.0	5.0	10.8	8.6	71.6	1.17
1971	Oct. 25 - Nov. 22	85.0	7.5	7.5	13.4	9.8	64.9	1.06
	Nov. 23 - Dec. 21	75.0	18.5	6.5	12.6	9.1	68.2	1.12
	Dec. 22 - Feb. 15	60.0	32.0	8.0	13.1	9.5	70.0	1.15
	Feb. 15 - Slau.	60.0	33.0	7.0	12.6	9.1	71.0	1.16
1972	Oct. 25 - Nov. 21	85.0	8.0	7.0	12.9	9.5	65.2	1.07
	Nov. 22 - Jan. 11	80.0	13.0	7.0	12.8	9.5	66.7	1.09
	Jan. 12 - Mar. 8	75.0	18.0	7.0	12.8	9.5	68.0	1.12
	Mar. 8 - Slau.	60.0	33.0	7.0	12.6	9.5	71.2	1.17

[a] Estimated composition based on N.R.C. values for the 1970 calf-crop and proximate analysis for the 1971 and 1972 calf-crops.
[b] The concentrate included varying amounts of ground shelled corn, ground sorghum grain, and ground wheat.
[c] Supplement contained 38% crude protein. Urea was used in the supplement for the 1972 calf-crop.

TABLE 5. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS FOR POSTWEANING AVERAGE DAILY GAINS, ADJUSTED FINAL WEIGHTS AND FEED EFFICIENCY
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Breed of Sire	Breed of Dam	No. Steers[a]				Postweaning Average Daily Gain[b]				Adjusted Final Weight[c]					Feed Efficiency (TDN and Mcal ME)[d]			
		212	247	279	Total	212	247	279	Avg.	212	247	279	Avg.	Ratio[e]	212	247	279	Avg.
Hereford	Hereford	23	24	22	69	2.42	2.30	2.28	2.33	955	1005	1090	1017	97.6				
Angus	Angus	28	28	29	85	2.35	2.26	2.15	2.25	952	1030	1057	1013	97.2				
	Average	51	52	51	154	2.38	2.28	2.21	2.29	954	1018	1074	1015	97.4	6.17	6.74	6.97	6.63
															(10.12)	(11.05)	(11.43)	(10.87)
Angus	Hereford	31	34	32	97	2.42	2.42	2.35	2.39	961	1060	1125	1049	100.7				
Hereford	Angus	39	37	38	114	2.35	2.30	2.24	2.29	960	1048	1096	1035	99.3				
	Average	70	71	70	211	2.38	2.36	2.29	2.34	961	1054	1110	1042	100.0	6.34	6.81	7.09	6.75
															(10.40)	(11.17)	(11.63)	(11.07)
Jersey	Hereford	17	18	18	53	2.41	2.14	2.17	2.24	938	975	1068	994	95.4				
	Angus	27	27	27	81	2.21	2.13	2.05	2.13	929	979	1030	979	93.9				
	Average	44	45	45	134	2.31	2.13	2.11	2.18	934	977	1049	986	94.6	6.64	7.21	7.37	7.07
															(10.89)	(11.83)	(12.09)	(11.59)
South Devon	Hereford	14	16	14	44	2.51	2.49	2.40	2.47	977	1068	1128	1057	101.4				
	Angus	16	17	17	50	2.55	2.50	2.29	2.45	1013	1091	1129	1078	103.5				
	Average	30	33	31	94	2.53	2.49	2.34	2.46	995	1080	1128	1068	102.5	6.30	6.83	7.06	6.73
															(10.33)	(11.20)	(11.58)	(11.04)
Limousin	Hereford	28	28	29	86	2.36	2.41	2.28	2.35	992	1070	1093	1052	101.0				
	Angus	30	30	29	89	2.29	2.35	2.25	2.30	987	1082	1121	1063	102.0				
	Average	59	58	58	175	2.32	2.38	2.27	2.32	990	1076	1107	1058	101.5	6.19	6.56	6.93	6.56
															(10.15)	(10.76)	(11.37)	(10.76)
Simmental	Hereford	27	29	26	82	2.70	2.63	2.62	2.65	1047	1135	1213	1132	108.6				
	Angus	30	32	33	95	2.43	2.45	2.48	2.46	1023	1111	1201	1112	106.7				
	Average	57	61	59	177	2.57	2.54	2.55	2.55	1035	1123	1207	1122	107.7	6.23	6.69	6.91	6.61
															(10.22)	(10.97)	(11.33)	(10.84)
Charolais	Hereford	25	27	26	78	2.81	2.61	2.60	2.67	1074	1128	1189	1131	108.5				
	Angus	32	34	34	100	2.57	2.47	2.47	2.50	1066	1113	1206	1128	108.2				
	Average	57	61	60	178	2.69	2.54	2.53	2.59	1070	1121	1197	1129	108.3	6.31	6.74	6.80	6.62
															(10.35)	(11.05)	(11.15)	(10.86)
Average	Hereford	166	176	167	509	2.52	2.43	2.38	2.44	992	1063	1129	1061	101.8				
All Sire	Angus	202	205	207	614	2.39	2.35	2.28	2.34	990	1065	1120	1058	101.5				
Breeds	Average	368	381	374	1123	2.46	2.39	2.33	2.39	991	1064	1125	1060	101.7	6.31	6.80	7.02	6.71
															(10.35)	(11.15)	(11.51)	(11.00)

[a] Number of steers slaughtered for the 3 years after an average of 212, 247 and 279 days on feed.
[b] ADG = (actual final wt. - actual weaning wt.) ÷ days on feed, adjusted for year and to a mature age of dam basis.
[c] Adj. Final Wt. = 200-day wt. + (postwn. A.D.G. x days on feed postwn.), adj. for year and to a mature age of dam basis.
[d] Metabolizable Energy (M.E.) values are shown in parentheses. TDN Efficiency = lb. TDN consumed per lb. gain. Mcal M.E. = lb. TDN x 1.64.
[e] Ratio computed relative to the average of 1042 lb. for Angus-Hereford and Hereford-Angus crossbred controls.

TABLE 6. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS FOR HOT CARCASS WEIGHT, DRESSING PERCENT, U.S.D.A. QUALITY GRADE AND MARBLING SCORE[a]
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Breed of Sire	Breed of Dam	Hot Carcass Wt., lb.				Dressing Percent				U.S.D.A. Quality Grade[b]				Marbling Score[c]			
		212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.
Hereford	Hereford	593	630	676	633	60.1	60.8	60.7	60.5	11.0	11.0	11.6	11.2	9.5	9.6	11.0	10.0
Angus	Angus	603	661	673	646	60.8	61.8	61.9	61.5	12.2	12.5	12.7	12.5	12.5	12.7	14.5	13.2
	Average	598	646	675	639	60.4	61.3	61.3	61.0	11.6	11.7	12.2	11.8	11.0	11.1	12.7	11.6
Angus	Hereford	598	664	711	657	60.1	61.3	61.9	61.1	11.7	12.0	12.3	12.0	11.0	12.0	13.4	12.1
Hereford	Angus	607	668	706	661	60.6	61.5	62.0	61.4	11.6	11.8	11.8	11.7	11.2	11.2	11.8	11.4
	Average	602	666	709	659	60.4	61.4	61.9	61.2	11.6	11.9	12.0	11.9	11.1	11.6	12.6	11.8
Jersey	Hereford	576	601	662	613	59.0	59.6	60.4	59.7	10.9	11.2	11.8	11.3	11.3	12.4	14.5	12.7
	Angus	585	617	647	617	60.4	60.1	60.3	60.3	11.8	12.3	12.2	12.1	14.2	14.2	15.6	14.7
	Average	580	609	654	6 5	59.7	59.9	60.3	60.0	11.3	11.7	12.0	11.7	12.7	13.3	15.0	13.7
South Devon	Hereford	603	669	715	663	60.5	61.4	61.9	61.3	11.2	11.4	11.9	11.5	10.3	10.4	12.4	11.0
	Angus	642	701	714	686	61.4	62.5	61.9	61.9	11.9	12.3	12.1	12.1	11.8	12.3	13.2	12.4
	Average	623	685	714	674	61.0	61.9	61.9	61.6	11.6	11.8	12.0	11.8	11.0	11.4	12.8	11.7
Limousin	Hereford	611	669	674	652	61.0	61.7	61.3	61.3	10.2	10.4	11.0	10.5	8.1	8.4	9.7	8.7
	Angus	620	685	707	670	61.6	62.3	62.2	62.0	10.8	10.8	11.1	10.9	9.4	9.4	10.3	9.7
	Average	615	677	690	661	61.3	62.0	61.7	61.7	10.5	10.6	11.0	10.7	8.7	8.9	10.0	9.2
Simmental	Hereford	638	696	740	691	59.5	60.3	60.2	60.0	10.8	11.0	10.8	10.9	9.8	9.4	9.6	9.6
	Angus	643	695	746	695	60.7	60.8	61.1	60.9	11.3	11.3	11.6	11.4	10.8	10.3	11.8	11.0
	Average	640	696	743	693	60.1	60.6	60.7	60.4	11.1	11.1	11.2	11.1	10.3	9.8	10.7	10.3
Charolais	Hereford	668	700	753	707	60.9	60.5	61.1	60.8	10.5	10.9	11.8	11.0	8.8	9.3	12.2	10.1
	Angus	672	710	768	717	60.9	61.9	62.1	61.7	11.4	11.9	12.1	11.8	10.7	11.5	12.7	11.6
	Average	670	705	760	712	60.9	61.2	61.6	61.2	10.9	11.4	11.9	11.4	9.7	10.4	12.4	10.9
Average	Hereford	613	661	704	659	60.1	60.8	61.1	60.7	10.9	11.1	11.6	11.2	9.8	10.2	11.8	10.6
All Sire	Angus	625	677	709	670	60.9	61.6	61.6	61.4	11.6	11.8	12.0	11.8	11.5	11.7	12.8	12.0
Breeds	Average	619	669	707	665	60.5	61.2	61.4	61.0	11.2	11.5	11.8	11.5	10.7	10.9	12.3	11.3

[a] Data for all traits are adjusted for year and to a mature age of dam basis.
[b] U.S.D.A. Quality Grade: 10=average good, 11=high good, 12=low choice, 13=average choice, etc.
[c] Marbling Score: 9=slight+, 10=small-, ... 21=slightly abundant+.

TABLE 7. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS FOR U.S.D.A. YIELD GRADE, RIBEYE AREA, FAT THICKNESS AND PERCENT KIDNEY, PELVIC AND HEART FAT[a]
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Breed of Sire	Breed of Dam	U.S.D.A. Yield Grade				Ribeye Area, sq. in.				Fat Thickness, in.				Estimated Percent Kidney, Pelvic and Heart Fat			
		212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.
Hereford	Hereford	3.0	3.1	3.5	3.2	10.7	11.5	11.4	11.2	.44	.58	.60	.53	2.4	2.5	2.6	2.5
Angus	Angus	3.4	3.6	3.7	3.6	10.9	11.6	11.6	11.4	.60	.69	.77	.68	3.3	3.4	3.0	3.2
	Average	3.2	3.4	3.6	3.4	10.8	11.5	11.5	11.3	.52	.63	.68	.61	2.8	2.9	2.8	2.9
Angus	Hereford	3.1	3.5	3.7	3.5	11.2	11.6	12.0	11.6	.53	.67	.74	.65	3.0	3.1	2.8	2.9
Hereford	Angus	3.2	3.7	3.9	3.6	11.2	11.3	11.9	11.5	.57	.70	.80	.69	2.8	2.9	3.0	2.9
	Average	3.2	3.6	3.8	3.5	11.2	11.4	12.0	11.5	.56	.68	.77	.67	2.9	3.0	2.9	2.9
Jersey	Hereford	3.1	3.3	3.7	3.4	10.9	10.9	11.4	11.0	.30	.40	.54	.41	4.7	4.7	4.9	4.8
	Angus	3.4	3.5	3.8	3.5	11.0	11.1	11.3	11.1	.51	.50	.59	.53	4.6	4.8	5.0	4.8
	Average	3.2	3.4	3.7	3.5	10.9	11.0	11.3	11.1	.41	.45	.56	.47	4.6	4.8	4.9	4.8
South Devon	Hereford	2.9	3.2	3.7	3.3	11.7	11.8	11.7	11.7	.41	.50	.55	.48	3.6	3.4	3.5	3.5
	Angus	2.9	3.3	3.5	3.2	12.1	12.4	12.4	12.3	.45	.54	.64	.54	3.3	3.7	3.8	3.6
	Average	2.9	3.3	3.6	3.3	11.9	12.1	12.0	12.0	.43	.51	.59	.51	3.5	3.5	3.6	3.5
Limousin	Hereford	2.2	2.4	2.8	2.4	12.5	13.3	12.7	12.8	.34	.41	.48	.41	2.5	3.0	2.9	2.8
	Angus	2.2	2.8	2.8	2.6	12.8	12.9	13.4	13.0	.37	.45	.51	.44	2.9	3.3	3.2	3.1
	Average	2.2	2.6	2.8	2.5	12.6	13.1	13.0	12.9	.35	.43	.50	.42	2.7	3.1	3.1	3.0
Simmental	Hereford	2.3	2.6	2.8	2.6	12.3	12.5	12.8	12.5	.32	.38	.44	.38	2.8	2.8	2.8	2.8
	Angus	2.6	2.9	3.2	2.9	12.3	12.6	12.7	12.5	.40	.44	.53	.46	3.2	3.4	3.4	3.3
	Average	2.5	2.7	3.0	2.7	12.3	12.6	12.7	12.5	.36	.41	.48	.42	3.0	3.1	3.1	3.1
Charolais	Hereford	2.4	2.4	2.7	2.5	12.5	13.0	13.1	12.9	.33	.35	.42	.36	2.8	2.7	2.8	2.8
	Angus	2.4	2.8	2.9	2.7	12.8	13.0	13.9	13.2	.36	.45	.52	.44	2.8	3.3	3.4	3.2
	Average	2.4	2.6	2.8	2.6	12.7	13.0	13.5	13.1	.34	.40	.47	.40	2.8	3.0	3.1	3.0
Average All Sire Breeds	Hereford	2.7	3.0	3.3	3.0	11.7	12.1	12.2	12.0	.38	.47	.54	.46	3.1	3.2	3.2	3.2
	Angus	2.9	3.2	3.4	3.2	11.9	12.1	12.4	12.1	.47	.54	.62	.54	3.3	3.5	3.6	3.5
	Average	2.8	3.1	3.3	3.1	11.8	12.1	12.3	12.1	.42	.50	.58	.50	3.2	3.3	3.4	3.3

[a] Data for all traits are adjusted for year and to a mature age of dam basis.

TABLE 8. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS FOR ACTUAL PERCENT CUTABILITY, PERCENT RETAIL PRODUCT, PERCENT FAT TRIM AND PERCENT BONE[a]
CYCLE 1, PHASE I - 1970-71-72 CALF-CROP

Breed of Sire	Breed of Dam	Actual Cutability, %[b]				Retail Product, %[c]				Fat Trim, %				Bone, %			
		212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.
Hereford	Hereford	54.9	54.0	52.6	58.8	68.3	66.8	64.9	66.7	18.4	20.7	23.1	20.8	13.3	12.5	11.9	12.6
Angus	Angus	53.6	51.4	51.4	52.1	67.5	64.9	64.0	65.5	20.3	23.8	24.9	23.0	12.2	11.3	11.1	11.6
	Average	54.2	52.7	52.0	53.0	67.9	65.8	64.5	66.1	19.4	22.2	24.0	21.9	12.8	11.9	11.5	12.1
Angus	Hereford	53.2	52.4	51.8	52.4	66.9	65.4	64.2	65.5	20.5	22.7	24.2	22.5	12.6	11.9	11.6	12.1
Hereford	Angus	53.2	51.4	51.1	51.9	66.7	64.2	63.4	64.8	20.9	24.1	25.6	23.5	12.4	11.6	11.0	11.7
	Average	53.2	51.9	51.4	52.2	66.8	64.8	63.8	65.1	20.7	23.4	24.9	23.0	12.5	11.8	11.3	11.9
Jersey	Hereford	53.6	52.2	51.7	52.5	67.1	65.1	64.0	65.4	19.6	22.2	23.8	21.9	13.2	12.7	12.2	12.7
	Angus	52.1	51.4	51.0	51.5	65.9	64.6	63.6	64.7	22.0	23.5	24.7	23.4	12.1	11.9	11.7	11.9
	Average	52.8	51.8	51.4	52.0	66.5	64.8	63.8	65.1	20.8	22.9	24.2	22.6	12.7	12.3	12.0	12.3
South Devon	Hereford	53.9	53.2	52.1	53.1	67.3	66.6	64.3	66.0	19.6	20.9	23.8	21.5	13.1	12.5	11.9	12.5
	Angus	54.2	52.8	52.1	53.1	68.0	66.3	64.9	66.4	19.5	21.9	23.5	21.6	12.5	11.9	11.6	12.0
	Average	54.0	53.0	52.1	53.1	67.6	66.4	64.6	66.2	19.6	21.4	23.6	21.5	12.8	12.2	11.8	12.3
Limousin	Hereford	58.6	56.3	55.7	56.9	71.8	69.7	68.3	70.0	14.6	17.7	19.3	17.2	13.6	12.6	12.4	12.9
	Angus	57.9	56.0	55.5	56.5	71.5	69.4	68.2	69.7	15.3	18.5	19.8	17.9	13.1	12.1	11.9	12.4
	Average	58.2	56.2	55.6	56.7	71.6	69.6	68.3	69.8	15.0	18.1	19.5	17.5	13.4	12.3	12.2	12.6
Simmental	Hereford	56.7	55.5	55.2	55.8	70.2	68.6	67.9	68.9	15.4	17.8	18.8	17.4	14.3	13.6	13.3	13.7
	Angus	55.4	54.8	54.1	54.8	68.9	68.0	66.9	67.9	17.6	19.1	20.5	19.1	13.4	12.8	12.6	12.9
	Average	56.1	55.2	54.7	55.3	69.6	68.3	67.4	68.4	16.5	18.5	19.7	18.2	13.9	13.2	12.9	13.3
Charolais	Hereford	57.1	56.7	56.3	56.7	70.8	69.9	68.9	69.9	15.7	16.9	18.1	16.9	13.5	13.2	13.0	13.2
	Angus	56.4	55.3	54.7	55.5	70.0	68.7	67.5	68.7	16.6	18.9	20.5	18.7	13.3	12.4	12.1	12.6
	Average	56.8	56.0	55.5	56.1	70.4	69.3	68.2	69.3	16.2	17.9	19.3	17.8	13.4	12.8	12.5	12.9
Average	Hereford	55.4	54.3	53.6	54.5	68.9	67.4	66.1	67.5	17.7	19.9	21.6	19.7	13.4	12.7	12.3	12.8
All Sire	Angus	54.7	53.3	52.8	53.6	68.4	66.6	65.5	66.8	18.9	21.4	22.8	21.0	12.7	12.0	11.7	12.2
Breeds	Average	55.1	53.8	53.2	54.0	68.6	67.0	65.8	67.1	18.3	20.6	22.2	20.4	13.1	12.4	12.0	12.5

[a] Data for all traits are adjusted for year and to a mature age of dam basis.
[b] Actual Cutability, % = Actual yield of boneless, closely trimmed beef from the round, loin, rib and chuck.
[c] Retail Product, % = Actual yield of boneless, closely trimmed beef from the carcass.

TABLE 9. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS FOR WARNER-BRATZLER SHEAR AND TASTE PANEL EVALUATION OF COOKED STEAKS[a]
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Breed of Sire	Breed of Dam	Warner-Bratzler Shear, lb.[b]				Taste Panel Tenderness[c]				Taste Panel Flavor[c]				Taste Panel Juiciness[c]				Taste Panel Acceptability[c]			
		212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.	212	247	279	Avg.
Hereford	Hereford	7.0	6.6	7.2	6.9	7.6	7.3	7.4	7.4	7.5	7.4	7.4	7.4	7.1	6.8	7.0	7.0	7.3	7.2	7.3	7.3
Angus	Angus	7.1	7.0	7.0	7.0	7.5	7.2	7.4	7.4	7.7	7.4	7.5	7.5	7.1	7.1	7.1	7.1	7.4	7.2	7.3	7.3
	Average	7.0	6.8	7.1	7.0	7.5	7.3	7.4	7.4	7.6	7.4	7.4	7.5	7.1	7.0	7.0	7.0	7.4	7.2	7.3	7.3
Angus	Hereford	6.8	7.1	6.7	6.8	7.6	7.8	7.4	7.6	7.5	7.5	7.4	7.5	7.2	7.2	6.9	7.1	7.4	7.5	7.2	7.4
Hereford	Angus	7.9	7.1	7.3	7.4	7.3	7.3	7.6	7.4	7.3	7.3	7.7	7.4	7.1	6.8	7.3	7.1	7.2	7.2	7.5	7.3
	Average	7.3	7.1	7.0	7.1	7.5	7.5	7.5	7.5	7.4	7.4	7.5	7.5	7.2	7.0	7.1	7.1	7.3	7.3	7.3	7.3
Jersey	Hereford	7.0	6.7	6.7	6.8	7.4	7.7	7.8	7.6	7.7	7.6	7.6	7.6	7.3	7.0	7.5	7.3	7.5	7.5	7.5	7.5
	Angus	6.6	6.1	6.6	6.5	7.6	7.8	7.4	7.6	7.6	7.5	7.6	7.6	7.4	7.3	7.4	7.4	7.4	7.5	7.4	7.4
	Average	6.8	6.4	6.6	6.6	7.5	7.8	7.6	7.6	7.6	7.5	7.6	7.6	7.4	7.2	7.5	7.3	7.4	7.5	7.5	7.5
South Devon	Hereford	6.8	6.8	6.8	6.8	7.6	7.4	7.4	7.5	7.5	7.6	7.2	7.4	7.0	7.1	7.2	7.1	7.4	7.4	7.2	7.3
	Angus	6.5	6.5	6.2	6.4	7.8	7.7	7.7	7.7	7.5	7.4	7.6	7.5	7.5	7.2	7.2	7.3	7.4	7.4	7.5	7.4
	Average	6.7	6.6	6.5	6.6	7.7	7.5	7.5	7.6	7.5	7.5	7.4	7.5	7.2	7.1	7.2	7.2	7.4	7.4	7.4	7.4
Limousin	Hereford	7.4	7.5	7.6	7.5	7.2	6.7	7.2	7.0	7.5	7.4	7.6	7.5	7.3	6.8	7.2	7.1	7.3	6.8	7.2	7.1
	Angus	7.4	7.5	7.7	7.5	7.7	7.1	7.1	7.3	7.5	7.4	7.5	7.5	7.1	6.9	6.9	7.0	7.4	7.1	7.2	7.2
	Average	7.4	7.5	7.6	7.5	7.4	6.9	7.1	7.2	7.5	7.4	7.5	7.5	7.2	6.9	7.0	7.0	7.3	6.9	7.2	7.2
Simmental	Hereford	7.9	7.7	7.5	7.7	6.6	7.0	6.7	6.7	7.2	7.5	7.4	7.4	7.1	6.7	6.9	6.9	6.8	7.0	6.9	6.9
	Angus	7.8	7.3	7.4	7.5	7.5	7.3	7.0	7.3	7.6	7.6	7.4	7.6	7.2	7.4	7.1	7.2	7.4	7.4	7.0	7.3
	Average	7.8	7.5	7.5	7.6	7.0	7.1	6.8	7.0	7.4	7.6	7.4	7.5	7.1	7.1	7.0	7.1	7.1	7.2	7.0	7.1
Charolais	Hereford	7.0	7.4	7.2	7.2	7.4	7.2	7.3	7.3	7.4	7.4	7.6	7.5	7.1	6.9	7.3	7.1	7.2	7.3	7.4	7.3
	Angus	6.9	6.6	7.0	6.8	7.7	7.4	7.6	7.6	7.5	7.5	7.7	7.6	7.2	6.9	7.1	7.1	7.4	7.3	7.5	7.4
	Average	6.9	7.0	7.1	7.0	7.5	7.3	7.5	7.4	7.5	7.5	7.7	7.5	7.1	6.9	7.2	7.1	7.3	7.3	7.4	7.3
Average All Sire Breeds	Hereford	7.1	7.1	7.1	7.1	7.3	7.3	7.3	7.3	7.5	7.5	7.5	7.5	7.2	6.9	7.1	7.1	7.3	7.2	7.2	7.2
	Angus	7.2	6.9	7.0	7.0	7.6	7.4	7.4	7.5	7.5	7.4	7.6	7.5	7.2	7.1	7.1	7.1	7.4	7.3	7.4	7.3
	Average	7.2	7.0	7.1	7.1	7.5	7.3	7.3	7.4	7.5	7.5	7.5	7.5	7.2	7.0	7.1	7.1	7.3	7.3	7.3	7.3

[a] Data for all carcass traits are adjusted for year and to a mature age of dam basis.
[b] A measure of the pounds of force required to shear one-half inch cores of steaks cooked at 350°F to 150°F internal temperature and cooled for 30 minutes at room temperature. Warner-Bratzler shear was obtained on steaks from all 1123 steers.
[c] Taste panel scores are based on a 9-point hedonic scale, with higher scores indicating greater acceptability. Taste panel traits were measured on steaks from 4 steers per sire-dam breed group per slaughter date per year (72 per sire breed group for the three years).

TABLE 10. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS FOR POSTWEANING GROWTH, PUBERTY AND CONCEPTION OF HEIFERS
CYCLE 1, PHASE I - 1970-71-72 CALF-CROPS

Breed of Sire	Breed of Dam	No. Heifers	200-Day Postwn. ADG, lb.	Adj. 400-Day Wt., lb.[a]	Adj. 550-Day Wt., lb.[b]	Reaching Puberty, %[c]	Adjusted[d] Puberty Age, days	Adjusted[d] Puberty Wt., lb.	Percent Pregnant[e]
Hereford	Hereford	65	0.99	591	677	78.1	420	618	80.5
Angus	Angus	64	1.10	629	694	99.4	367	567	84.7
	Average	129	1.04	610	686	88.8	394	593	82.6
Angus	Hereford	68	1.18	627	712	94.4	383	580	86.8
Hereford	Angus	65	1.14	652	730	97.6	370	595	87.9
	Average	133	1.16	640	721	96.0	377	588	87.4
Jersey	Hereford	61	1.02	584	664	100.0	335	499	92.6
	Angus	56	0.96	578	656	99.3	321	474	83.7
	Average	117	0.99	581	660	99.7	328	487	88.2
South Devon	Hereford	63	1.22	653	743	91.2	379	615	85.4
	Angus	57	1.21	669	738	98.1	350	589	82.3
	Average	120	1.21	661	740	94.7	365	602	83.9
Limousin	Hereford	83	1.13	625	712	73.2	421	664	71.8
	Angus	78	1.12	656	728	98.7	377	623	91.1
	Average	161	1.12	641	720	86.0	399	644	81.5
Simmental	Hereford	90	1.19	684	780	89.7	381	658	82.3
	Angus	67	1.21	692	771	100.0	356	616	86.7
	Average	157	1.20	688	776	94.9	369	637	84.5
Charolais	Hereford	79	1.16	673	773	92.8	407	676	81.4
	Angus	54	1.20	697	785	95.4	391	670	79.8
	Average	133	1.18	685	779	94.1	399	673	80.6
Average All Sire Breeds	Hereford	509	1.13	634	723	88.5	389	616	83.0
	Angus	441	1.13	653	729	98.4	362	591	85.2
	Average	950	1.13	644	726	93.5	376	603	84.1

[a] Adjusted 400-day wt. = 200-day wt. + (200-day postweaning ADG x 200 days), adjusted for year and birth date.
[b] Adjusted 550-day wt. = 200-day wt. + (350-day postweaning ADG x 350 days), adjusted for year and birth date.
[c] Estrus was determined from weaning to an average of approximately 15 months of age (end of AI) for the 1970 calf-crop and to an average of approximately 16 months of age (end of AI plus cleanup) for the 1971-72 calf-crops.
[d] Adjusted to comparable values if puberty had been detected in 100% of the heifers in all breed groups.
[e] The breeding period was 45 to 46 days by AI and 21 to 24 days by natural service.

TABLE 11. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BIRTH WEIGHT AND CALVING DIFFICULTY OF THE 2-YEAR-OLD COWS[a]
CYCLE 1, PHASE II COWS BORN IN 1970-71

Cow				Type of Parturition, %				Dead at or Shortly After Birth (No.)
Breed of Sire	Breed of Dam	No. Calves	Calf Birth Wt., lb.	No Difficulty[b]	Calf Puller	C-Section	Abnormal Presentation	
Hereford	Hereford	31	61.7	48.4	38.7	3.2	9.7	4
Angus	Angus	36	62.6	67.6	18.9	0.0	13.5	0
	Average[c]	68	62.2	58.0	28.8	1.6	11.6	4
Angus	Hereford	41	69.8	46.3	41.5	7.3	4.9	3
Hereford	Angus	45	66.6	57.8	33.3	6.7	2.2	3
	Average[c]	86	68.2	52.1	37.4	7.0	3.6	6
Jersey	Hereford	49	64.9	81.6	14.3	0.0	4.1	2
	Angus	30	61.6	73.3	20.0	0.0	6.7	2
	Average[c]	79	63.3	77.5	17.2	0.0	5.4	4
South Devon	Hereford	31	73.7	38.7	48.4	6.5	6.5	0
	Angus	35	72.7	42.9	48.6	5.7	2.9	5
	Average[c]	66	73.2	40.8	48.5	6.1	4.7	5
Limousin	Hereford	30	66.6	63.3	30.0	0.0	6.7	2
	Angus	48	71.1	54.2	39.6	2.1	4.2	4
	Average[c]	78	68.9	58.8	34.8	1.1	5.5	6
Simmental	Hereford	49	72.2	46.9	40.8	8.2	4.1	2
	Angus	41	74.0	43.9	39.0	9.8	7.3	3
	Average[c]	90	73.1	45.4	39.9	9.0	5.7	5
Charolais	Hereford	41	73.7	52.4	33.3	7.1	7.1	1
	Angus	22	73.6	63.6	27.3	0.0	9.1	1
	Average[c]	64	73.7	58.0	30.3	3.6	8.1	2
Average All Sire Breeds	Hereford[c]	272	68.9	53.9	35.3	4.6	6.2	14
	Angus[c]	257	68.9	57.6	32.4	3.5	6.6	18
	Average[c]	529	68.9	55.8	33.8	4.0	6.4	32

[a] Calves from these cows were sired by Hereford, Angus, Devon, Holstein and Brahman bulls (Appendix table 3).
[b] No assistance or minor hand assistance.
[c] Unweighted means.

TABLE 12. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING AND REBREEDING OF THE 2-YEAR-OLD COWS[a]
CYCLE 1, PHASE II COWS BORN IN 1970-71

Cow		No.	Avg.		Postpartum		Cow Wt.
Breed of Sire	Breed of Dam	Calving as 2-Year-Olds	Calving Date	Bred AI, %[b]	Interval, Days[c]	Percent Pregnant[b]	at 2½ Yrs. of Age, lb.
Hereford	Hereford	31	April 1	67.7	83	87.1	845
Angus	Angus	36	March 26	88.9	79	86.1	889
	Average[d]	67	March 29	78.3	81	86.6	867
Angus	Hereford	41	March 22	85.0	82	89.7	849
Hereford	Angus	45	March 25	90.9	90	86.4	908
	Average[d]	86	March 24	88.0	86	88.1	879
Jersey	Hereford	49	March 22	91.5	78	97.9	799
	Angus	30	March 21	100.0	78	90.0	774
	Average[d]	79	March 22	95.8	78	94.0	786
South Devon	Hereford	31	April 3	71.0	77	74.2	906
	Angus	35	March 25	85.7	83	85.7	925
	Average[d]	66	March 30	78.4	80	80.0	916
Limousin	Hereford	30	April 13	63.3	71	83.3	912
	Angus	48	March 28	81.3	80	75.0	910
	Average[d]	78	April 5	72.3	76	79.2	911
Simmental	Hereford	49	March 24	81.6	85	77.6	949
	Angus	41	March 25	87.8	87	78.0	929
	Average[d]	90	March 25	84.7	86	77.8	939
Charolais	Hereford	41	March 29	80.5	85	77.5	982
	Angus	22	March 25	77.3	94	72.7	1022
	Average[d]	63	March 27	78.9	90	75.1	1002
Average	Hereford[d]	272	March 30	77.2	80	83.9	892
All Sire	Angus[d]	257	March 25	87.4	84	82.0	908
Breeds	Average[d]	529	March 28	82.3	82	83.0	900

[a] Includes only cows that calved as 2-year-olds.
[b] The breeding period was 45 days by AI and 22 days by natural service. Percent pregnant = no. palpated as pregnant ÷ no. palpated.
[c] Interval from calving to first estrus.
[d] Unweighted mean.

TABLE 13. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BIRTH WEIGHT AND CALVING DIFFICULTY OF THE 3-YEAR-OLD COWS[a]
CYCLE 1, PHASE II COWS BORN IN 1970

Cow				Type of Parturition, %				Dead at or Shortly After Birth (No.)
Breed of Sire	Breed of Dam	No. Calves	Calf Birth Wt., lb.	No Difficulty[b]	Calf Puller	C-Section	Abnormal Presentation	
Hereford	Hereford	22	70.4	86.4	9.1	4.5	0.0	1
Angus	Angus	19	70.8	78.9	10.5	0.0	10.5	1
	Average[c]	41	70.6	82.7	9.8	2.3	5.3	2
Angus	Hereford	19	80.5	73.7	15.8	5.3	5.3	1
Hereford	Angus	21	81.9	61.9	23.8	4.8	9.5	2
	Average[c]	40	81.2	67.8	19.8	5.1	7.4	3
Jersey	Hereford	26	70.5	88.5	3.8	0.0	7.7	2
	Angus	13	71.8	69.2	30.8	0.0	0.0	0
	Average[c]	39	71.2	78.9	17.3	0.0	3.9	2
South Devon	Hereford	13	84.9	53.8	30.8	0.0	15.4	0
	Angus	15	84.9	73.3	13.3	6.7	6.7	1
	Average[c]	28	84.9	63.6	22.1	3.4	11.1	1
Limousin	Hereford	26	82.3	73.1	26.9	0.0	0.0	1
	Angus	19	82.0	73.7	26.3	0.0	0.0	0
	Average[c]	45	82.2	73.4	26.6	0.0	0.0	1
Simmental	Hereford	21	87.9	66.7	19.0	9.5	4.8	0
	Angus	17	81.5	76.5	17.6	0.0	5.9	1
	Average[c]	38	84.7	71.6	18.3	4.8	5.4	1
Charolais	Hereford	31	85.7	67.7	25.8	3.2	3.2	1
	Angus	12	88.7	66.7	25.0	0.0	8.3	1
	Average[c]	43	87.2	67.2	25.4	1.6	5.8	2
Average All Sire Breeds	Hereford[c]	158	80.3	72.8	18.7	3.2	5.2	6
	Angus[c]	116	80.2	71.5	21.0	1.6	5.8	6
	Average[c]	274	80.3	72.2	19.9	2.4	5.5	12

[a] Calves from these cows were sired by Hereford, Angus, Gelbvieh, Maine Anjou and Chianina bulls (Appendix table 3).
[b] No assistance or minor hand assistance.
[c] Unweighted means.

TABLE 14. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING AND REBREEDING OF THE 3-YEAR-OLD COWS[a]
CYCLE 1, PHASE II COWS BORN IN 1970

Cow		No.	Avg.	Postpartum		Cow Wt.
Breed of Sire	Breed of Dam	Calving as 3-Year-Olds	Calving Date	Interval, Days[b]	Percent Pregnant[c]	at 3½ Yrs. of Age, lb.
Hereford	Hereford	22	April 2	67	95.5	942
Angus	Angus	19	April 10	58	84.2	910
	Average	41	April 6	63	89.9	926
Angus	Hereford	19	March 25	65	89.5	939
Hereford	Angus	21	April 8	62	95.2	1021
	Average	40	April 1	64	92.4	980
Jersey	Hereford	26	March 26	68	100.0	847
	Angus	13	March 21	76	84.6	792
	Average	39	March 24	72	92.3	820
South Devon	Hereford	13	April 1	67	83.3	1034
	Angus	15	April 13	50	86.7	1010
	Average	28	April 7	59	85.0	1022
Limousin	Hereford	26	April 11	63	95.7	1020
	Angus	19	March 27	63	100.0	1022
	Average	45	April 4	63	97.9	1021
Simmental	Hereford	21	April 9	67	90.5	1041
	Angus	17	March 31	63	94.1	1034
	Average	38	April 5	65	92.3	1038
Charolais	Hereford	31	April 10	58	96.7	1086
	Angus	12	April 2	76	90.9	1120
	Average	43	April 6	67	93.8	1103
Average All Sire Breeds	Hereford[d]	158	April 3	65	93.0	987
	Angus[d]	116	April 3	64	90.8	987
	Average[d]	274	April 3	65	91.9	987

[a] Includes only cows that calved as 3-year-olds.
[b] Interval from calving to first estrus.
[c] Breeding period was 64 days by natural service to Brown Swiss bulls. Percent pregnant = no. palpated as pregnant ÷ no. palpated.
[d] Unweighted means.

TABLE 15. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY IN 4-5-6-7-8-YEAR-OLD COWS
CYCLE 2, PHASE I - 1973 CALF-CROP

Breed of Sire	Breed of Dam	No. Calves	Type of Parturition, %				Dead at or Shortly After Birth, %
			No Calving Difficulty[a]	Calf-Puller	C-Section	Abnormal Presentation	
Hereford	Hereford	39	97.4	0.0	0.0	2.6	0.0
Angus	Angus	57	96.5	1.8	0.0	1.8	0.0
	Average[b]	96	97.0	0.9	0.0	2.2	0.0
Angus	Hereford	45	93.3	0.0	0.0	6.7	0.0
Hereford	Angus	52	90.4	1.9	0.0	7.7	5.8
	Average[b]	97	91.9	1.0	0.0	7.2	2.9
Red Poll	Hereford	43	93.0	4.7	0.0	2.3	0.0
	Angus	50	100.0	0.0	0.0	0.0	2.0
	Average[b]	93	96.5	2.4	0.0	1.2	1.0
Brown Swiss	Hereford	48	87.5	8.3	0.0	4.2	0.0
	Angus	50	94.0	6.0	0.0	2.0	2.0
	Average[b]	98	90.8	7.2	0.0	3.1	1.0
Gelbvieh	Hereford	50	90.0	8.0	0.0	2.0	8.0
	Angus	59	86.4	11.9	0.0	1.7	1.7
	Average[b]	109	88.2	10.0	0.0	1.9	4.9
Maine Anjou	Hereford	43	79.1	16.3	0.0	4.7	4.7
	Angus	53	77.4	18.9	0.0	3.8	11.3
	Average[b]	96	78.3	17.6	0.0	4.3	8.0
Chianina	Hereford	45	82.2	11.1	0.0	6.7	11.1
	Angus	46	89.1	8.7	0.0	2.2	2.2
	Average[b]	91	85.7	9.9	0.0	4.5	6.7
Average All Sire Breeds	Hereford[b]	313	88.9	6.9	0.0	4.2	3.4
	Angus[b]	367	90.5	7.0	0.0	2.7	3.6
	Average[b]	680	89.7	7.0	0.0	3.5	3.5

[a] No assistance or minor hand assistance.
[b] Unweighted means.

TABLE 16. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY IN 4-5-6-7-8-YEAR-OLD COWS
CYCLE 2, PHASE I - 1973 CALF-CROP

Breed of Sire	Breed of Dam	No. Calves[a]	Type of Parturition, %				Dead at or Shortly After Birth, %
			No Calving Difficulty[b]	Calf-Puller	C-Section	Abnormal Presentation	
Hereford	Hereford	39	97.4	0.0	0.0	2.6	0.0
	Angus	52	90.4	1.9	0.0	7.7	5.8
	Red Poll	24	75.0	16.7	4.2	4.2	0.0
	Brown Swiss	16	100.0	0.0	0.0	0.0	6.3
	Average[c]	131	90.7	4.7	1.1	3.6	3.0
Angus	Hereford	45	93.3	0.0	0.0	6.7	0.0
	Angus	57	96.5	1.8	0.0	1.8	0.0
	Red Poll	25	96.0	4.0	0.0	0.0	0.0
	Brown Swiss	19	100.0	0.0	0.0	0.0	0.0
	Average[c]	146	96.5	1.5	0.0	2.1	0.0
Red Poll	Hereford	43	93.0	4.7	0.0	2.3	0.0
	Angus	50	100.0	0.0	0.0	0.0	2.0
	Red Poll	24	95.8	0.0	4.2	0.0	4.2
	Brown Swiss	12	100.0	0.0	0.0	0.0	0.0
	Average[c]	129	97.2	1.2	1.1	0.6	1.6
Brown Swiss	Hereford	48	87.5	8.3	0.0	4.2	0.0
	Angus	50	94.0	6.0	0.0	2.0	2.0
	Red Poll	25	64.0	28.0	4.0	4.0	8.0
	Brown Swiss	22	95.5	0.0	0.0	4.5	6.7
	Average[c]	145	85.3	10.6	1.0	3.7	4.2
Average All Sire Breeds	Hereford[c]	175	92.8	3.3	0.0	4.0	0.0
	Angus[c]	209	95.2	2.4	0.0	2.9	2.5
	Red Poll[c]	98	82.7	12.2	3.1	2.1	3.1
	Brown Swiss[c]	69	98.9	0.0	0.0	1.1	3.3
	Average[c]	551	92.4	4.5	0.8	2.5	2.2

[a] Calves from Hereford and Angus dams are also included in table 15.
[b] No assistance or minor hand assistance.
[c] Unweighted means.

TABLE 17. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS OF PREWEANING TRAITS - 1973 CALF-CROP
CYCLE 2, PHASE I

Breed of Sire	Breed of Dam	No. Calves[a]	Birth Date	Birth Wt., lb.[b]	Preweaning ADG, lb.[b]	Adjusted 200-Day Wt., lb.[b]	200-Day Wt. Ratio[c]
Hereford	Hereford	35	April 2	84.2	1.61	406	94.9
Angus	Angus	51	March 27	75.1	1.79	433	101.2
	Average	86	March 30	79.7	1.70	420	98.1
Angus	Hereford	44	April 1	80.5	1.67	415	97.0
Hereford	Angus	48	March 27	82.7	1.79	441	103.0
	Average	92	March 29	81.6	1.73	428	100.0
Red Poll	Hereford	41	April 2	84.9	1.67	419	97.9
	Angus	47	March 29	79.1	1.81	441	103.0
	Average	88	March 31	82.0	1.74	430	100.5
Brown Swiss	Hereford	48	April 4	89.5	1.74	437	102.1
	Angus	47	March 29	87.4	1.90	467	109.1
	Average	95	April 1	88.5	1.82	452	105.6
Gelbvieh	Hereford	43	April 5	89.9	1.78	446	104.2
	Angus	52	March 28	85.9	1.94	473	110.5
	Average	95	April 1	87.9	1.86	460	107.5
Maine Anjou	Hereford	37	April 2	95.0	1.71	438	102.3
	Angus	43	March 31	91.2	1.89	469	109.6
	Average	80	April 1	93.1	1.80	454	106.1
Chianina	Hereford	38	April 7	95.5	1.79	453	105.8
	Angus	42	March 31	91.1	1.95	488	114.0
	Average	80	April 4	93.3	1.87	471	110.0
Average All Sire Breeds	Hereford	286	April 3	88.5	1.71	431	100.7
	Angus	330	March 29	84.6	1.87	459	107.2
	Average	616	April 1	86.6	1.79	445	104.0

[a] Includes all steer and heifer calves that were weaned.
[b] Adjusted for birth date and to a steer and mature age-of-dam basis.
[c] Ratio computed relative to average of 428 lb. for Angus-Hereford and Hereford-Angus crossbred controls.

TABLE 18. U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
LEAST SQUARES MEANS OF PREWEANING TRAITS - 1973 CALF-CROP
CYCLE 2, PHASE I

Breed of Sire	Breed of Dam	No. Calves[a]	Birth Date	Birth Wt., lb.[b]	Preweaning ADG, lb.[b]	Adjusted 200-Day Wt., lb.[b]	200-Day Wt. Ratio[c]
Hereford	Hereford	35	April 2	84.2	1.61	406	86.8
	Angus	48	March 27	82.7	1.79	441	94.2
	Red Poll	23	March 28	89.3	1.82	453	96.8
	Brown Swiss	15	April 1	103.0	2.26	555	118.6
	Average	121	March 30	89.8	1.87	464	99.1
Angus	Hereford	44	April 1	80.5	1.67	415	88.7
	Angus	51	March 27	75.1	1.79	433	92.5
	Red Poll	24	March 24	84.0	1.94	471	100.6
	Brown Swiss	18	March 30	90.2	2.24	538	115.0
	Average	137	March 28	82.5	1.91	464	99.1
Red Poll	Hereford	41	April 2	84.9	1.67	419	89.5
	Angus	47	March 29	79.1	1.81	441	94.2
	Red Poll	23	March 29	88.3	1.81	451	96.4
	Brown Swiss	11	March 27	94.5	2.24	542	115.8
	Average	122	March 30	86.7	1.88	463	98.9
Brown Swiss	Hereford	48	April 4	89.5	1.74	437	93.4
	Angus	47	March 29	87.4	1.90	467	99.8
	Red Poll	23	April 1	95.6	2.01	497	106.2
	Brown Swiss	19	April 13	99.5	2.14	527	112.6
	Average	137	April 4	93.0	1.95	482	103.0
Average All Sire Breeds	Hereford	168	April 2	84.8	1.68	419	89.5
	Angus	193	March 28	81.1	1.82	446	95.3
	Red Poll	93	March 28	89.3	1.89	468	100.0
	Brown Swiss	63	April 2	96.8	2.22	541	115.6
	Average	517	March 31	88.0	1.90	468	100.0

[a] Includes all steer and heifer calves that were weaned. Calves from Hereford and Angus dams are also included in table 17.
[b] Adjusted for birth date and to a steer and mature age-of-dam basis.
[c] Ratio computed relative to overall average of 468 lb.

APPENDIX

TABLE 1. MATING PLANS - CYCLE 1, PHASE I GPE

1969, 1970, 1971 Breeding Seasons

Dam Breeds[a]	Sire Breeds						
	Here-ford	Angus	Jersey	South Devon	Limou-sin	Sim-mental	Charo-lais
Hereford	X	X	X	X	X	X	X
Angus	X	X	X	X	X	X	X

[a] The cows were 1, 2, 3 and 4-year-olds in 1969; 1, 2, 3, 4 and 5-year-olds in 1970; and 2, 3, 4, 5 and 6-year-olds in 1971.

TABLE 2. MATING PLANS - CYCLE 2, PHASE I GPE

1972 and 1973 Breeding Seasons

Dam Breeds[a]	Sire Breeds						
	Here-ford[b]	Angus[b]	Red Poll	Brown Swiss	Gelb-vieh	Maine Anjou	Chia-nina
Hereford	X	X	X	X	X	X	X
Angus	X	X	X	X	X	X	X
Red Poll	X	X	X	X			
Brown Swiss	X	X	X	X			

[a] Cows used for GPE Cycle 1, Phase I, 1969, 1970 and 1971 breeding seasons.
[b] Sample of same Hereford and Angus sires used in Cycle 1, Phase I, 1969, 1970 and 1971 breeding seasons.

APPENDIX

TABLE 3. MATING PLANS - CYCLE 1, PHASE II

Breed Group[a]	Sire Breeds: First Calf-Crop[b] Here-ford[e]	Angus[e]	Brah-man	Devon	Hol-stein	Second Calf-Crop[c] Here-ford[e]	Angus[e]	Gelb-vieh	Maine Anjou	Chia-nina	3rd and 4th Calf-Crops[d] Brown Swiss
H x H		X					X				X
A x A	X					X					X
A x H			X	X	X			X	X	X	X
H x A			X	X	X			X	X	X	X
J x H		X	X	X	X		X	X	X	X	X
J x A	X		X	X	X	X		X	X	X	X
SD x H		X	X	X	X		X	X	X	X	X
SD x A	X		X	X	X	X		X	X	X	X
L x H		X	X	X	X		X	X	X	X	X
L x A	X		X	X	X	X		X	X	X	X
S x H		X	X	X	X		X	X	X	X	X
S x A	X		X	X	X	X		X	X	X	X
C x H		X	X	X	X		X	X	X	X	X
C x A	X		X	X	X	X		X	X	X	X

[a] Females of each breed group distributed equally among cells marked "X" for each calf-crop.
[b] Each group of heifers bred as yearlings to produce one calf-crop as 2-year-olds by these breeds.
[c] Each group of cows bred as 2-year-olds to produce one calf-crop as 3-year-olds by these breeds.
[d] Each group of cows bred to produce at least two calf-crops by this breed.
[e] Sample of same sires used in Cycle 1, Phase I, 1969-70-71 breeding seasons.